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Levels of noradrenaline and adrenaline in the cerebral ganglia of the land snail *Achatina fulica* Bowdich in respect to aestivation.

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The role of monoamines occurring in nerve ganglia of molluscs is still speculative (Hill and Welsh, 1966; Osborne, 1984; Coon and Bonar, 1986; Croll, 1987a; 1987b; 1988; Panigrahi *et al.*, 1992; 1994). Since certain molluscs, especially terrestrial ones, are adapted to overcome a long period of environmental hazards by undergoing either aestivation or hibernation it is of interest to know whether such phenomena are influenced by the monoamines or if the rate of synthesis or release of monoamines is influenced by these phenomena. Accordingly the aestivation of giant African land snails, *Achatina fulica* Bowdich, occurring in Calcutta was studied.

Achatina fulica in Calcutta aestivate with the onset of dry weather, usually during the first half of November. Depending on weather conditions the snails spend six to eight months in aestivation (Raut, 1991a). For the present study a total of 200 individuals between 50 and 55 mm in shell length and 42.61 and 44.53 g in body weight were collected from the garden of the Institute of Jute Technology, Ballygunge, Calcutta in October 1988. They were released into four terraria (each 75 x 50 x 20 cm in size) in equal numbers and reared following the technique described by Raut (1991b). Keeping parity with the natural time of aestivation the snails of two terraria were deprived of food and moisture (by discontinuing water spraying on the soil of the terrarium) from November 12, 1988. Most of the snails aestivated during the next three days. By this time at least 75% of the snails in the garden of the Institute of Jute Technology aestivated at the same time. On the first day of aestivation (November 15, 1986) four active individuals (two from each of the terraria where the snails were kept active) and four individuals from the drying terraria were separated for study. These individuals were weighed and anaesthetized with chloroform. The cerebral ganglia of these snails were quickly dissected out and processed for spectrophotofluometric determination of noradrenaline and adrenaline following Cox and Perhach (1973) and Laverty and Taylor (1968). The estimation of monoamines present was made with a Hitachi Model 650–10M fluorescence spectrophotometer as described by Mahata and Ghosh (1989). Similar sampling of cerebral ganglia was undertaken monthly. Since aestivated snails failed to survive beyond April 12, 1989 the final sampling was conducted on March 15, 1989. In all cases three readings were taken to calculate the mean amount of monoamines (noradrenaline and adrenaline) in the cerebral ganglia.

Noradrenaline and adrenaline levels in aestivated and active (control) *A. fulica* are presented in Table 1 and statistically analyzed in Table 2. Variations in noradrenaline and adrenaline levels in the cerebral ganglia of *A. fulica* are clear. While the fall in the levels of these amines in the first 30 days of aestivation can be attributed to the effects

Table 1. Levels of monoamines in μg/g tissue (±S.D.) in *Achatina fulica*.

Sampling Dates	Active (Control)		Aestivated	
	Noradrenaline	Adrenaline	Noradrenaline	Adrenaline
November 15, 1988	14.39 (1.64)	12.62 (1.22)	14.39 (1.64)	12.62 (1.22)
December 15, 1988	12.70 (1.09)	17.17 (1.23)	3.58 (0.45)	7.26 (1.22)
January 15, 1989	15.93 (1.04)	18.47 (1.19)	37.87 (1.47)	40.97 (1.81)
February 15, 1989	24.17 (1.33)	21.43 (1.26)	43.85 (1.00)	64.24 (1.52)
March 15, 1989	27.53 (1.48)	26.16 (0.91)	42.77 (1.28)	67.24 (1.43)

of the onset of aestivation, the subsequent gradual increase in these amines is perhaps dependent on the physiological adjustment of the snails to the interacting effects of the length of aestivation and climatic factors. Since the snails used are adapted to undergo aestivation with the onset of adverse climatic conditions they were not able to overcome this even if kept active under favourable conditions during the natural aestivation period. As a result noradrenaline and adrenaline were synthesized at an increasing rate over time corresponding to the normal aestivation period.

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Table 2. Results of Analysis of Variance (ANOVA) and student's 't' test (indicated by P-values).

Source of variation	d.f.	SS	MS	F.cal	Ftab (P=0.05)	Remarks
Month (A)	4	9485.618	2371.404	926.026	2.61	S
Expt. (B)	1	3106.809	3106.809	1213.199	4.08	S
Noradrenaline/ Adrenaline (C)	1	394.7031	394.7031	154.1303	4.08	S
A x B	4	3953.274	988.3184	385.9353	2.61	S
A x C	4	320.711	80.17774	31.30916	2.61	S
B x C	1	360.9766	360.9766	140.9602	4.08	S
A x B x C	4	542.543	135.6357	52.96532	2.61	S
Error	40	102.4336	2.56084	–	–	–
Total	59	18267.07	–	–	–	–

S = Significant.

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